ALC-601

Compact, flexible and robust.
6 line laser combiner

ANDOR
an Oxford Instruments company

Enhanced Laser Illumination

- ☑ *Flexible configuration- up to 6 lines*
- ☑ *Supports multiple devices covering a broad range of applications*
- ☑ *High stability and robust design delivers optimal performance*

Features and Benefits

- **Next generation laser combiner**
  Enhanced power delivery and stability at single mode fibre outputs
- **Borealis compatible**
  Use multi-mode fibres with homogenizer for high intensity imaging
- **Multi-port fibre switch**
  Supports complex microscopy systems
- **Direct laser TTL control**
  For user-defined precision control
- **Linearised power output**
  Corrects for AOTF non-linearity
- **Power down lasers**
  Switch off unused lasers to extend lifetime
- **Power threshold protection**
  Do not exceed power limit for delicate fibres
- **Class IIIB compliant version**
  Support for up to 500mW
- **Class IV (> 500mW) version**
  For super-resolution and related applications
- **Highly flexible and configurable platform**
  System may be built to your specific requirements
- **Customer Special Request (CSR) system**
  Specialised and experimental configurations are available using our CSR system

The multi-line laser source delivering flexibility for demanding application needs

The Andor Laser Combiner (ALC) is now in its 3rd generation, delivering a highly configurable laser delivery package to meet a wide variety of imaging application needs. Our long standing expertise in laser combiners means that you can be certain of owning a robust device with optimum performance both optically and mechanically, and which delivers a highly stable output. Laser safety is paramount in the design of the ALC-601 which is primarily supplied as a Class IIIb CDRH compliant device (up to 500mW) and includes full interlock connectivity.

Offering up to 6 laser lines from 405nm up to 660nm, across a broad range of power options, you can configure the ALC-601 according to your budget and application needs. Laser line selection and power control are managed though an accousto-optical tuneable filter (AOTF), resulting in laser switching and incremental power control in the microsecond range. Enhance the ALC-601, with a multi-port unit (MPU) to provide high speed switching between two or three outputs to support multi-mode imaging. For example use a three port MPU for multi-point confocal TIRF illuminator and active illumination for photo-bleaching, photo-switching or uncaging.

Included with the ALC-601 is the Precision Control Unit (PCU) which provides 8 TTL input and 8 TTL output channels as well as AOTF control. This provides the functionality, with the appropriate software, to send and receive trigger commands to peripheral devices as part of an imaging experiment. Additional TTL connectivity is provided for direct laser modulation, if desired, and an ultra-fast driver module (UFDM) can also be added for applications such as FLIM (Fluorescence lifetime microscopy) and ALEX (Kapanidis *et al*., 2005).

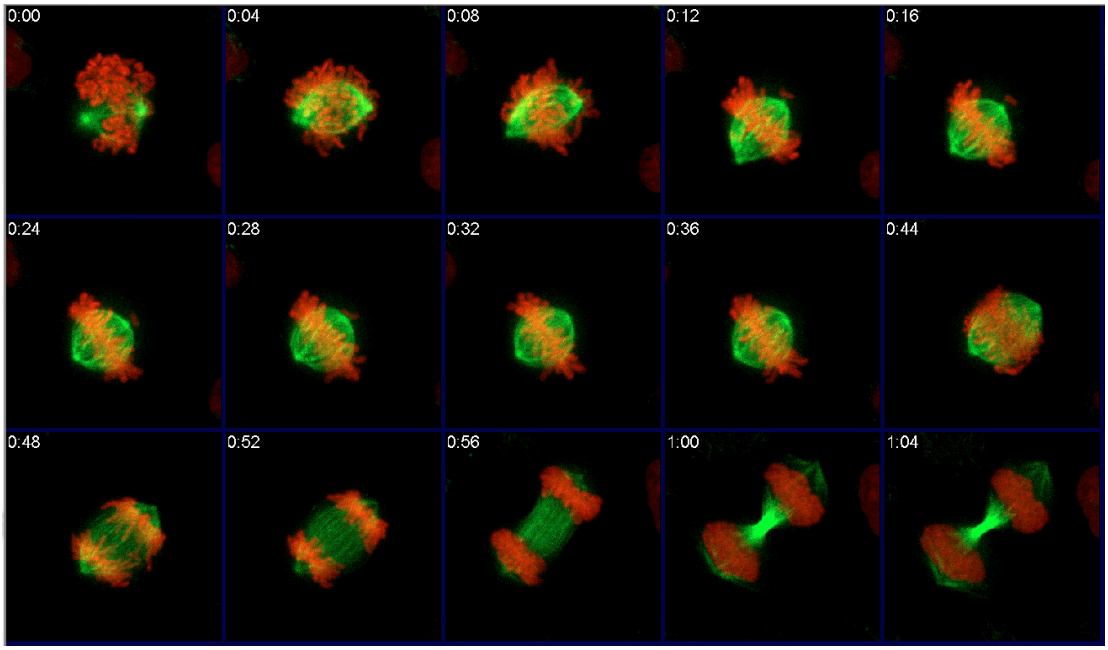
Key Specifications

Max number of lasers	6
Wavelength range (nm)	405-660
TTL control interface	8 TTL input and 8 TTL output channels
Integral AOTF	clean emission , <2 µs wavelength switching
Active Laser blanking	2 µs on/off times
Linearized power control	Linearity <5% FSD, Resolution 0.1%
Optional multi-port unit	2,3 ports: switching time <2 ms all ports
Optional ultra-fast driver	up to 150 MHz TTL modulation
High power option	>500 mW Class IV

Laser modulation options

ALC-601 uses an integral AOTF for control of all laser lines and this provides significant benefits:

- First, it provides high speed and precision across the full intensity range (100-0.1%; 0.1% steps) making the ALC-601 an ideal product for complex imaging needs, like localization microscopy and minimal exposure microscopy (O'Connell *et al.*, 2009 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2762104/)
- Second, the AOTF provides fast gating for Active Laser Blanking, minimizing specimen exposure and readout artefacts when combined with ultra-sensitive EMCCD and rolling shutter sCMOS cameras.
- Third, ALC-601 delivers extremely rapid wavelength switching (~2 µs) and simultaneous multi-band excitation.
- Finally, for experiments requiring ultra-fast switching, like alternating laser excitation ALEX (Kapanidis *et al.* 2005 http://www.conoptics.com/wp-content/uploads/2013/09/Alternating-Laser_Excitation_of_Single_Molecules.pdf) the AOTF can be left open on multiple simultaneous channels and the ALC Ultra-fast driver board is available for direct modulation up to the laser maximum (150 MHz for some diode lasers).



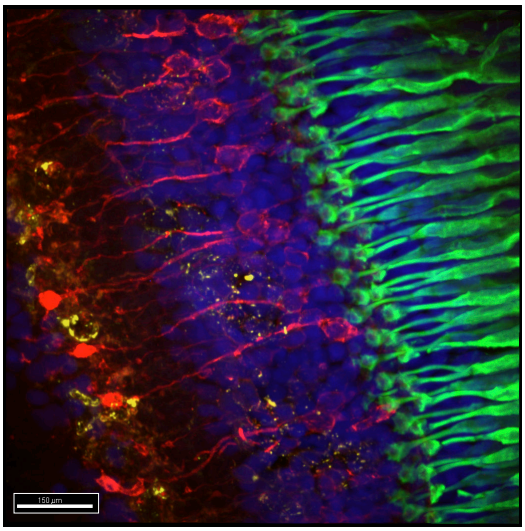
Left: Time lapse images showing mitosis in HeLa cells (time in hr:min) This experiment illustrates how minimal exposure combined with laser spinning disk microscopy preserves live cell health and function..
Image Courtesy of Alexey Khodjakov, Division of Translational Medicine, Wadsworth Center, New York State Department of Health, Albany, NY.

ALC-601 laser options

The laser wavelengths and powers supported are outlined in the table below.
An ultra-fast driver module (UFDM) is available for applications requiring 10's MHz switching rates.

Wavelength (nm)	Power Rating (mW)
405***	100
445***	40, 50
488***	50, 60
488**	50, 100, 150^{+}, 200^{+}
491.5*	50, 100
515*	50, 100, 150^{+}
532**	50, 100, 150^{+}, 200^{+}, 300^{+}
561.2*	50, 100, 150, 200, 500^{+}
593.6*	50, 100
640***	100
659.6*	400^{+}

Wavelength variation (nm) depends on laser type: * ±0.3, ** ±2, *** ±5
$^{+}$ denotes on special request.



Above: Maximum intensity projection of z-series from Zebrafish retina highlighting nuclei (blue), green and red sensitive cones (green) and 2 different types of bipolar cells (red & yellow). *Courtesy of Tim McGinn, Stenkamp Lab, University of Idaho, USA.*

Specifications[•1]

Optical Specifications

Specification		Single Fibre Output	MPU Dual or Triple Fibre Outputs
Laser Configurations		Up to 6 Diode Lasers 5 Diode + 1DPSS/OPSS Lasers 4 Diode + 2DPSS/OPSS Lasers 3 Diode + 3DPSS/OPSS Lasers 1 Diode Laser (@ 640nm) + 4 DPSS/OPSS Lasers	
Laser Output Power (Fibre Coupled)		500mW Maximum for Class IIIB Class IV (>500mW emission) version available under CSR	
Fibre coupled Power Stability		≤2% per °C	
RMS Noise (10Hz – 10MHz)		<1%	
Output Polarisation Extinction Ratio (Typ.)		>100:1	
Fibre Optic Type		Single mode, polarisation maintaining, stainless steel armoured cabling or multi-mode used with Borealis illumination.	
Fibre Output Connector		Selectable - FC/AFC, FC/APC, FC/PC	
Active Blanking (Electronic Shuttering)	Rise / Fall Time	<2 µS	
	Extinction Ratio	50 dB (fibre end: >60dB)	
	Signal Lag	<2 µS	
Digital Modulation (Diode Lasers)[•2]	Rise / Fall Time	<20 ns	
	Max. Freq.	150 MHz	
Digital Modulation (OPSS Lasers)	Rise / Fall Time	18/2 µS	
	Max. Freq.	50 kHz	
MPU Switching Speed (optional)		N/A	<2 mS (Port A-B or B-C) <2 mS (Port A-C)
MPU Max. Switching Freq. (Optional)		N/A	100 Hz

Electronic Specifications

Specification	Single Fibre Output	MPU Dual or Triple Fibre Outputs
Control Interface	USB2.0 and 37 Pin D-sub connector (PCI I/O Card included)	
Digital Modulation Option (UFDM)	6 x SMB Connectors (50Ω), TTL. Allows independent, asynchronous control	
FLIM Modulation Option (UFDM)	1 x BNC (50Ω) – Distributes the modulation signal to up to 4 diode lasers simultaneously, TTL. Software selection of individual laser control mode	
Active Blanking	3 x BNC (50Ω) Inputs with OR logic (Via PCU) AOTF controlled, shutters all output	
Digital Inputs	8 x BNC (50Ω), TTL (Via PCU)	
Digital Outputs	8 x BNC (50Ω), TTL (Via PCU)	
Power Supply Requirements	Mains: 100 – 240V a.c., 50 – 60Hz	
Power Consumption	350 W Max.	+ 15W (MPU Controller)
Laser Standby Mode	Independent Software control of each laser to greatly extend laser life ~ 90 seconds warm-up time after re-enable	
Laser Power Control	AOTF controlled, Linearised output, 0 – 100%, 0.1% resolution Linearity ±5%	
Laser Output Control	AOTF controlled, up to 6 lines with independent and asynchronous control Absolute maximum incident laser power = 5 W	

Mechanical Specifications

Specification	Single Fibre Output	MPU Dual or Triple Fibre Outputs
ALC-601 Dimensions (WxDxH)	483mm x 530mm x 184mm	483mm x 593mm x 210mm
ALC-601 Enclosure and Mounting Format	4U 19" Sub-rack BS EN 60297 (Aluminium Construction) Andor Revolution XD 19" Rack-mount Cabinet (Optional) Rubberised feet allow for bench-top mounting	
ALC-601 Weight	38Kg Max. (6 Lasers)	42kg Max. (6 Lasers)
PCU Dimensions (WxDxH)	483mm x 316mm x 133mm	
PCU Enclosure and Mounting Format	3U 19" Sub-rack BS EN 60297 (Aluminium Construction) Andor Revolution XD 19" Rack-mount Cabinet (Optional) Rubberised feet allow for bench-top mounting	
PCU Weight	8kg	
MPU Controller Dimensions (WxDxH)	483mm x 324mm x 95mm	
MPU Controller Enclosure and Mounting Format	2U 19" Sub-rack BS EN 60297 (Aluminium Construction) Andor Revolution XD 19" Rack-mount Cabinet (Optional) Rubberised feet allow for bench-top mounting	
MPU Controller Weight	5kg	

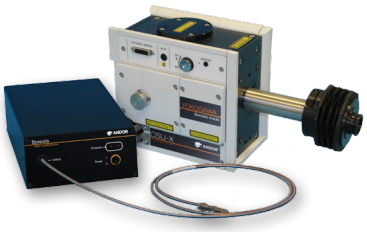
General Specifications

Specification	Single Fibre Output	MPU Dual or Triple Fibre Outputs
Control Software	Andor iQ MetaMorph Micro-Manager LabView Driver available on request	
Operating Temperature	23°C ± 5°C (Indoor use only)	
Operating Relative Humidity	<70% (Non-condensing)	
Storage Temperature	0 - 50°C	
Operating Altitude	Up to 2000 m	

Compliance Specifications

Certification	CE Compliant, CDRH Registered
Classification	Class IIIb (IEC 60825-1 and CDRH) Class IV (IEC 60825-1 and CDRH) available under special request
RoHS Compliant	Yes
Laser Safety Features	Key operated master switch, shrouded fibre connection, laser safety interlock kit inc. remote interlock connection

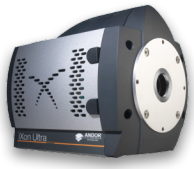
Borealis: high throughput and uniform illumination with CSU-X and CSU-W



Borealis enhanced CSU-X

Find out more about Borealis at: www.andor.com/microscopy-systems/revolution/borealis

Andor EMCCD and scientific CMOS: the ultimate in detection



Andor iXon EMCCD

Andor sCMOS

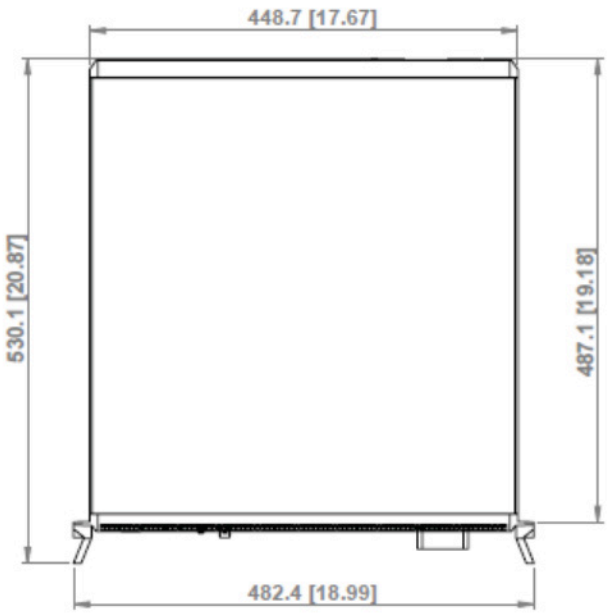
To find out more about Andor's range of EMCCD and scientific CMOS detectors, please see: www.andor.com/scientific-cameras

Product Drawings

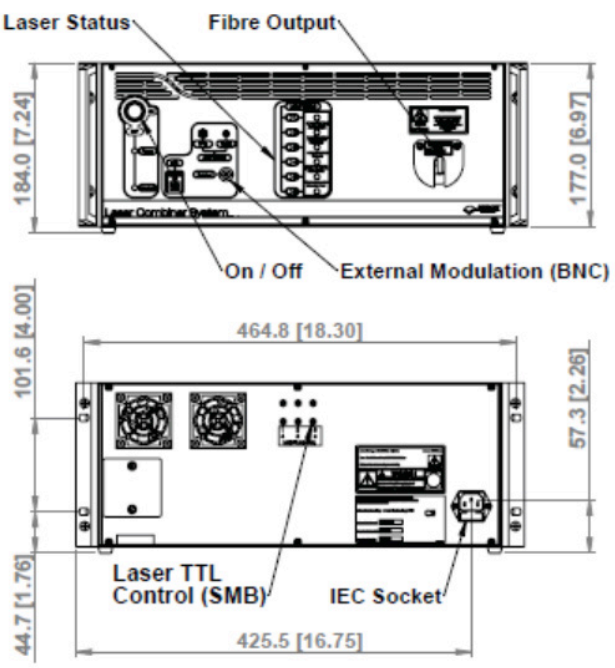
Dimensions in mm [inches]

Standard ALC-601

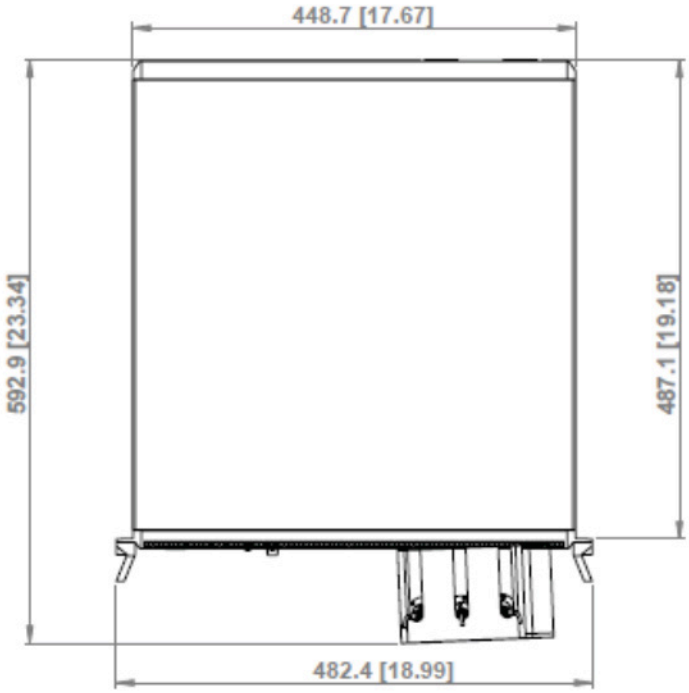
Top panel

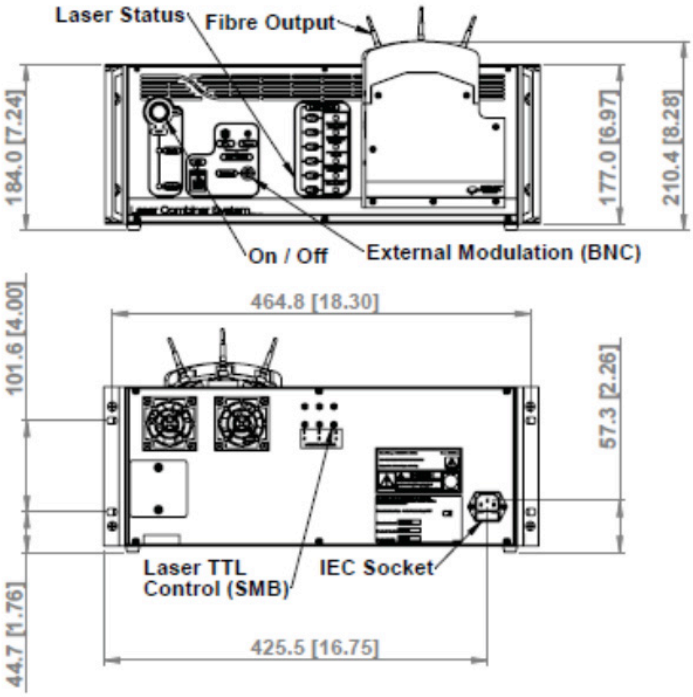


Front panel (top) and rear panel (below)

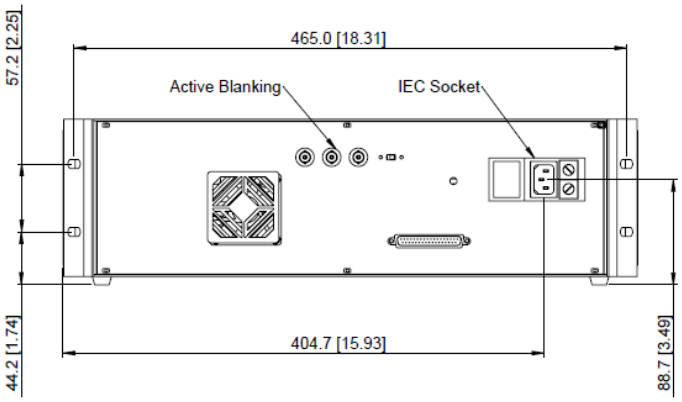


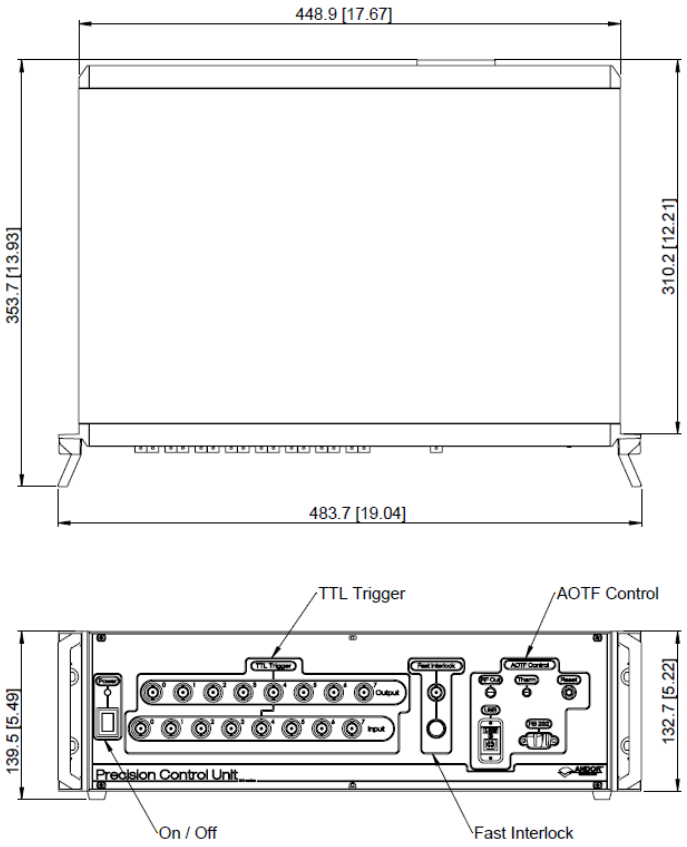
ALC-601 with MPU



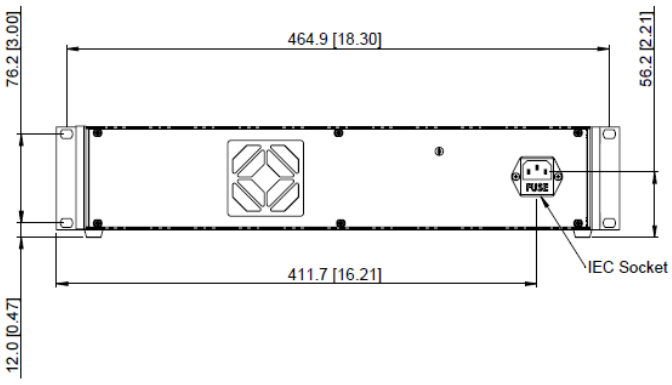


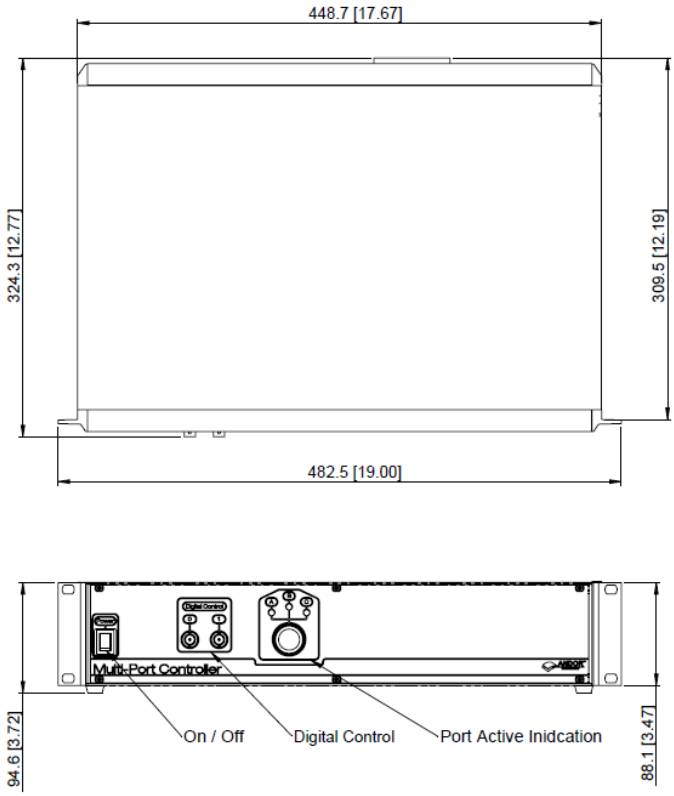
PCU





MPU Controller





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Our regional headquarters are:

Europe
Belfast, Northern Ireland
Phone +44 (28) 9023 7126
Fax +44 (28) 9031 0792

Japan
Tokyo
Phone +81 (3) 6732 8968
Fax +81 (3) 6732 8939

North America
Connecticut, USA
Phone +1 (860) 290 9211
Fax +1 (860) 290 9566

China
Beijing
Phone +86 (10) 8271 9066
Fax +86 (10) 8271 9055

Supplied Components

1 x ALC-601 (supplied with purchased lasers installed). ALC enclosures are 19" rack mount capable. An optional wheeled rack system is available.
1 x PCU-100 precision controller with TTL I/O and AOTF controller.
1 x Single or multi-mode optical fibre suitable for selected application (Borealis requires multi-mode).
1 x PCI-DAC card and D-37 cable for PC control interface.
1 x USB cable.
Power cords for local mains supply.
1x User Manual

Optional:
Ultra-fast driver module (UDFM) for high speed switching integrated into ALC enclosure.
MPU: multi-port head integrated with ALC; MPU controller.
Additional (one or two) single mode optical fibres for selected MPU.

Footnotes: Specifications are subject to change without notice

1. All specifications are typical.
2. Requires optional ultra-fast driver module (UFDM)
3. ALC-601 models are registered CDRH and IEC Class 3B or Class 4 according to laser selections.
4. Installation, service and upgrade should be performed by qualified personnel.
5. All local safety standards should be followed by users.
6. If your specific requirements are not covered in this document, please contact your sales channel. We will certainly consider special requests.

OXFORD INSTRUMENTS
The Business of Science®

Software Compatibility:
- Andor iQ, Micro-Manager, MetaMorph, QuickPALM, Software Development kit (SDK) available on request

Regulatory Compliance
- EU EMC/ LV/ Machinery/ RoHS Directives
- Laser safety compliant for IEC 60825-1 and CDRH 21 CFR 1040.10 (Class 4 under special request)

Operating & Storage Conditions
- Indoor use only
- Operating Temperature: 18°C to 28°C ambient
- Operating Relative Humidity: <70% (non-condensing)
- Operating Altitude: Up to 2000m
- Storage Temperature: 0°C to 50°C ambient

Power Requirements
- Mains Power supply: 100-240 VAC, 50/60 Hz
- Power consumption: 350 W Max. (+15W MPU Controller)

bsi. ISO 9001 Quality Management FM40523
bsi. ISO 14001 Environmental Management EMS91062
bsi. OHSAS 18001 Occupational Health and Safety Management OHS02497

CE